Review of the Master's Thesis from Anna Kratochvílová:
Visualization of Spatio-Temporal Data in GRASS GIS

Review Notes

0. Introduction:

Mixing "I" and "We" should be avoided.

1. Spatio-temporal data:

1.1 Efforts to integrate time with space

The last statement "Since these issues have not been completely solved until today we can expect that research efforts in this field will continue." needs citation or must be justified by the author.

As a starting point, May Yuan stated in "Challenges and Critical Issues for Temporal {GIS} Research and Technologies" 2009: "that most temporal GIS technology developed are still in the research phase or have an emphasis on mapping."

1.2 Spatio-temporal data models

1.2.1 The snapshot model

The term "field-based spatio-temporal data model" is not introduced, only stated. Galton and Goodchild wrote several papers about the distinction between field-based and object-based world views. Avoid the term "field-based" here, since the snapshot model is not restricted to field based data.

Also the ESTDM model was designed to avoid redundant data storage and to capture the change of states for raster data. Since the ESTDM model is introduced later, avoid to note the Base state with Amendments here which is also only vector oriented. It can be noted in the space time composite model.

1.3 Visualization

Using the term "events" here is confusing for me, but this may be related to the fact that i am not familiar with the "means of graphic sign system".

1.4 Existing software

"studying, modifying and sharing the software are often illegal"

Avoid this statement, since this is handled by the country specific license agreements and laws.

To study or to modify the software is not illegal, except when you need to break the protection/encryption of the software to study or modify it (in Germany for example). Proprietary software is not evil, its lacking freedom.

2. GRASS GIS

The concept of maps in GRASS should be clarified. Since many other GIS software are using the term "layer" instead of map.

2.4 Temporal GRASS GIS framework

Be consistent in the naming of the framework: "Temporal GRASS GIS framework" or "GRASS

GIS Temporal Framework"?

Make clear that the new tools are only available in the latest development version of GRASS7, maybe you can provide a svn revision.

2.4.1 Implementation

I would like to modify this part a bit, due the lack of documentation of the temporal framework:

The temporal framework uses the snapshot approach to handle spatio-temporal fields. The design is based on the field based view of geographical data (see Galton and Goodchild).

The snapshot approach was extended so that each time stamped spatial field (raster, vector, 3D raster) can have a different spatial and temporal extent. It supports the computation of spatio-temporal relationships between time stamped spatial fields to allow the investigation of spatio-temporal interactions between them.

2.4.2 Basic concepts

The left closed, right open time interval was chosen to easily detect gaps between time stamped maps.

In table 2.3 the temporal relationship follow/precedes is missing, since "meet" can be either follow or precede.

Regarding temporal sampling: Space time datasets can only be sampled by their own granularity using t.*.list. This works for all space time datasets, since its an abstract concept independent from the map type.

The draft temporal GIS paper is not very clear about the naming of temporal relationships: the TGRASS overlap statement includes "Allens" overlaps and overlapped.

2.4.3 Functionality

Please note that the GRASS GIS Temporal Framework is still in development.

It is a good idea to introduce the different space time datasets more detailed with full name: space time raster/3D raster/vector datasets.

These datasets are used as input and output for the temporal modules to simplify the handling of massive time series data.

SQL is used to specify temporal queries in many modules that can be combined with spatial and attribute queries (t.rast/rast3d/vect.extract).

The ntcdf output can directly be used in ParaView to visualize space time voxel cubes as time series.

3. Results

3.1 Animation Tool

A new tool "was" developed.

3.1.4 Implementation

Why makes the use of NumPy the code less readable?

How are space time raster datasets with invalid temporal topology handled?

Suggestion about the rendering:

RAM is an issue in the implemented animation approach in case you want to animate space time raster datasets with thousands of maps.

With the current approach thousands of maps with high resolution (monitor dependent) are hold in main memory using tens of gigabytes. I would suggest a file cache approach so that only a specific amount of maps is hold in the RAM. Maps are reloaded from the file system when needed. Special attention must be given to the slider feature in this case.

d.rast and d.vect can be used to create the bitmaps (PPM support can surely be implemented, but i would prefer PNG since there are small and quickly written) which are loaded into the animation tool right after a single bitmap was generated (parallel processing) until the buffer if full. Hence rendering can be done in background but the animation tool can already be used.

3.3 Timeline Tool

The timeline tool supports only the visualization of a 3D extent (t, x, y) but be aware that maps in space time vector and 3D raster datasets have 4D extents (t,x,y,z). Can this be handled or is the z dimension ignored?

3.3.2 Implementation

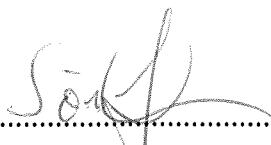No need to excuse using a development version of matplot.

Conclusion of the Review

The student fulfilled the assignment and the work is formally correct. The result is fully acceptable as a Master/Diploma Thesis.

The theoretical work covers most of the scientific work in this topic. The design and implementation of the temporal GIS visualization tools shows a deep understanding of the topic and excellent software implementation skills. This work is a great contribution to the Open Source GIS community and shows that the student is able to understand and improve complex GIS software.

I strongly suggest the grade **A** and an **award** for an excellent thesis.

Reviewed by:

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